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(54) A METHOD OF STARTING A STAND-BY ENGINE-DRIVEN EMERGENCY GENERATING SET

(71) We, KLOCKNER-HUMBOLDT-DEUTZ AKTIENGESELLSCHAFT, a German Body Corporate, or Köln-Deutz, German Federal Republic, do hereby declare the invention,

for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method of starting a stand-by emergency electric generating set driven by a fuel injection reciprocating piston internal combustion engine equipped with an exhaust-driven turbocharger, in which an electric motor is used to keep an inertial flywheel running constantly, and clutch means are used to connect the flywheel to the engine for starting the engine.

The object of an emergency power set is to ensure the substitution of an emergency electrical power supply within the shortest possible time after the failure of the power supply from the normal supply mains.

For this purpose the generator and the flywheel are continuously maintained by the mains-driven electric motor at speed slightly above the rated speed of the generator. When there is a breakdown in the power supply the clutch connecting the stationary internal combustion engine is engaged and the flywheel pulls the engine up to working speed.

In the case of an internal combustion engine of the normal air suction type, pulling the engine up to speed by the flywheel at once causes the engine to develop full power because the charge of fuel to each cylinder is that needed for full engine speed and power. However, in the case of internal combustion engines fitted with an exhaust-driven turbocharger the flywheel will likewise pull up the engine to its rated speed but the cylinders will not initially be effectively charged with air because the exhaust-driven turbocharger, not being directly driven by the engine, does not receive a sufficient supply of hot exhaust gases when the flywheel has brought the engine up to speed, so that the air supply to the engine cylinders is deficient. This results in a delayed development of full power by such an internal combustion engine.

In order to shorten the time which elapses until sufficient air is available for fully charging the cylinders with air it is at present practice to use small-sized turbochargers working at high speeds and capable of adapting themselves quickly to changing loads and speeds of the engine.

In internal combustion engines it is also the practice to adjust the fuel injection pump to deliver the full cylinder charge at the desired working speed. Since in supercharged engines the full air charge is not available during the starting period because the turbocharger picks up speed more slowly than the engine, the injection of the full volume of fuel is accompanied by the ejection of undesirable puffs of black smoke during the exhaust stroke of each cylinder. For this reason the volume of fuel injected is reduced by a special device to match the instantaneous charging pressure, and the emission of smoke is thus inhibited. However, this step even further reduces the volume of hot gas made available for driving the turbine, which consequently picks up speed even more slowly.

The resultant delay does not permit an emergency engine set of the contemplated kind to satisfy the basic requirements of rapid starting and of rapidly picking up the load.

It is therefore the main aim of the present invention, in a stand-by power set comprising a supercharged internal combustion engine, to reduce the time that elapses from the engine being started to the engine taking up the full load.

This is achieved in accordance with the invention by employing a method of starting a stand-by emergency electric generating set driven by a fuel injection reciprocating piston internal combustion engine equipped with an exhaust-driven turbocharger, in which an electric motor is used to keep an inertial flywheel running constantly, and clutch means are used to connect the flywheel to the engine for starting the engine,

the method comprising injecting into the air induction manifold of the engine, while running the engine up to speed, a liquid agent, such as methanol or a mixture of methanol and water, having a latent heat of evaporation higher than that of the liquid fuel used by the engine.

The additional injection of the liquid agent causes the exhaust-driven turbine to be accelerated much more rapidly because of the much higher entropy of the exhaust gases. The volume of fuel injected may correspond to the volume injected for a full cylinder charge, or to the reduced volume which, as mentioned earlier, is injected during the starting period when not using the additional liquid agent, in order to inhibit smoke in the exhaust.

Since the increased volume of fuel plus liquid agent incidentally subjects the components exposed to the combustion gases to a greater thermal stress, piston seizures or other damage might well occur were it not for the fact that the invention mitigates the effect of the increased volume by injecting a liquid agent which possesses a latent heat of evaporation higher than that of the fuel. Such additives having higher latent heats of evaporation provide good internal cooling, and they effectively prevent piston seizure or other damage due to overheating.

Suitable agents for achieving good internal cooling may be water or methanol or a mixture of both. Other known additives, such as ethanol, could also be used. These known fuel additives having latent heats of evaporation higher than that of the fuel are conveniently injected into the air induction manifold so that all cylinders receive equal doses.

It is a particular advantage of the invention that no change in the volumetric delivery of the injection pump during the starting period is needed. Indeed, the usual supplementary device, previously referred to, provided in internal combustion engines with exhaust turbochargers for reducing the injected volume of fuel during the starting period can be omitted. The increased starting volume of fuel plus liquid agent may be injected by reference to time instead of by reference to speed and maintained for up to a minute after start-up.

For a stand-by power set this has the advantage that smaller high power turbocharged internal combustion engines can be used which can be started by flywheels having smaller mass. The use of smaller flywheels incidentally means a considerable saving in energy which must otherwise be expanded when using larger flywheels to cover the air drag loss due to continuously maintaining the inertial masses running at stand-by speed.

WHAT WE CLAIM IS:—

1. A method of starting a stand-by emergency electric generating set driven by a fuel injection reciprocating piston internal combustion engine equipped with an exhaust-driven turbocharger, in which an electric motor is used to keep an inertial flywheel running constantly, and clutch means are used to connect the flywheel to the engine for starting the engine, the method comprising injecting into the air induction manifold of the engine, while running the engine up to speed, a liquid agent, such as methanol or a mixture of methanol and water, having a latent heat of evaporation higher than that of the liquid fuel used by the engine.

2. A method according to claim 1, of starting a stand-by engine-driven emergency generating set, the set comprising a fuel injection reciprocating piston internal combustion engine equipped with an exhaust-driven turbocharger, clutch means by which an inertial flywheel coupled to an elec-generator may be connected to the engine for running the engine up to speed, and further clutch means by which an electric motor may be connected to the inertial flywheel and the generator to maintain the flywheel and the generator running at a desired speed, substantially as herein described.

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